



EXPLORING THE USE OF ICT TOOLS IN MATHEMATICS AMONG SECONDARY LEVEL PRE-SERVICE TEACHERS

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ABSTRACT

The use of ICTs has been found to be effective in mathematics pedagogy, thus teacher education programmes need to prepare teachers who can effectively use technology in their mathematics teaching. This paper explores what are the various ICT tools the secondary level pre-service teachers use in their mathematics classrooms, what is the attitude of pre-service teachers towards using these and also the drawbacks of using technology as perceived by the pre-service teachers. The sample of the study consisted of 32 secondary level preservice teachers. Descriptive statistics and qualitative methods were used for analysis of the data collected through questionnaire and semi-structured interviews. Findings indicate a high level of awareness of various ICT tools in mathematics but the use in classrooms is mainly limited to presentation software. Attitude towards using technology, existing technology skills, technical and administrative support, classroom management, and ICT training received as a part of their training programme affects their use of technology.

KEYWORDS: ICT, Digital Tools, Mathematics Teaching, Pre-Service Teachers.

INTRODUCTION:

Teacher education needs to "orient and sensitize the teachers to distinguish between critically useful, developmentally appropriate and the detrimental use of ICTs which can be imaginatively drawn upon for professional development and academic support of the pre-service and in-service teachers" (NCTE, 2010).

ICT tools in mathematics are available in the form of mathematics apps such as Khan Academy, BYJU's, etc; mathematics software such as Graphmatica, Geogebra, Graphing Calculator, etc.; websites, e-learning material, Youtube channels such as ncert official etc, spreadsheet programs, concept mapping software can also be used in mathematics besides mathematics games and puzzles etc.

Many researches over the past decade have suggested that effective integration of ICTs result in effective teaching-learning of mathematics. Technology is important to teaching and learning of Mathematics (NCTM, 2000). Technology integration in mathematics teaching and learning can efficiently help children to develop better conceptual understanding of mathematics (Bennison & Goos, 2010). Keong et al. (2005) suggests having an e-portal for teaching mathematics consisting of two-modules: a resource repository having mathematical ICT tools for teaching and learning mathematics and another module of a lesson planner using which the resources from the repository can be integrated into lesson planning. Umoh & Akpan (2014) suggest that students' understanding and comprehension of the courses in Mathematics can be improved using blended e-learning approaches. They also concluded that the perceived challenges of blended e-learning tools in their institution contributes to enhancing the institutions' preparation of adopting blended e-learning approaches for the teaching and learning of Mathematics. Wachira & Keengwe 2011, suggested in their study that the pre-service teachers are able to recognise the cognitive and affective advantages of using technology to improve the students' understanding of mathematics, but for using the appropriate technologies with confidence in their classrooms they also require technology training to adopt appropriate pedagogy.

This paper explores the awareness about technology based mathematics lessons and also how the pre-service teachers perceive the need of using technology in mathematics lessons, the aim of the paper is also to investigate how the teacher preparation programs are preparing the pre-service teachers for integration of technology into mathematics classroom-teaching.

OBJECTIVES AND RESEARCH QUESTIONS:

The main objectives of the study are to:

1. Investigate the use of ICT tools among pre-service secondary level teachers.
2. Study the attitude of pre-service service teachers towards using ICT tools in their mathematics classrooms.

The research questions guiding the study were:

1. What are the main uses of computers among pre-service teachers for pedagogical purposes?
2. What are the various ICT tools in mathematics that the pre-service mathematics teachers are aware about?
3. How do the pre-service teachers integrate technology in their mathematics lesson planning?
4. What are the various technology integration skills in mathematics gained from the teacher preparation programme by the pre-service teachers?

SAMPLING AND DATA COLLECTION:

Method and Sample:

The sample of the study consisted of 32 secondary level preservice teachers, who have mathematics as one of their pedagogy subjects. The participants were enrolled in the two-year B.Ed. program in a Central University in the capital city of New Delhi, India, who engage in teaching internships in various government and private schools across the state of Delhi for a period of three months. These teachers are also required to conduct ICT based lessons during their internship teaching. Data was collected through a questionnaire and a semi structured interview. An individual semi structured interview was done with 12 pre-service teachers. Descriptive statistical analysis of likert type questions and qualitative analysis of the interview data gathered has been done.

Tools of data collection:

Tools of the study consisted of a 5 point likert type questionnaire and a semi structured interview schedule. This tool has been adapted from the study of Wachira & Keengwe (2011). The questionnaire consisted of 15 questions in total and also had open-ended questions. This was administered to 32 pre service teachers and based on the responses 12 were later selected for individual semi-structured interviews.

ANALYSIS AND FINDINGS:

Table 1.1: Use of Computers & Internet for Pedagogical Purposes in Mathematics

Use	Preparing PPTs involving multimedia	Youtube Videos	Solutions of textbook exercises	Accessing lesson plans on internet	Preparing PPTs involving text only	Using word processors for making worksheets
Frequency	20	14	17	05	03	02

Table 1.1 indicates the various uses of computers and internet for instructional purposes or the planning and preparation of classroom teaching by the pre-service teachers, which are, exploring the internet for mainly textbook exer-

cises' solutions in mathematics, youtube videos are also explored for classroom activities on various topics, the major use of computers is for making presentations or PPTs as indicated in the questionnaire.

Table 1.2: ICT Tools used for Teaching Mathematics

ICT Tool	Khan Academy videos integrated into PPTs	Youtube Videos integrated into PPTs	Geogebra Software	Khan Academy App	PPTs involving pictures and text material	Not Used Any
Frequency	03	04	02	01	21	09

Table 1.2 indicates the use of ICT tools in the actual mathematics classroom teaching, here a high use of PPTs that have text and pictures inserted into the slides. PPTs are also used by integrating links of videos on various Youtube channels, while 3 teachers reported integrating Khan Academy videos into their slides. Out of the sample of 32, use of mathematics software such as Geogebra was done by only 2 teachers and only 1 had used Khan Academy App in their mathematics classroom. Some teachers reported sometimes using PPTs where youtube and/or Khan academy Video links were integrated and sometimes using PPTs involving just text and pictures. However, 9 teachers reported not using any kind of ICT tools in their mathematics classrooms.

Table 1.3: Level of Technology Skills

Perceived level of technology skills	Mean	SD
1. Level of comfort in integrating technology in mathematics lessons	3.47	0.77
2. Pedagogy subject has prepared me to integrate technology into my future mathematics classroom	4.12	0.75
Grand Mean	3.79	

Table 1.3 indicates the level of technology skills as perceived by the pre-service teachers, a mean of 3.79 indicates a high level of technology skills among them, only 1 teacher out of 32 had reported a low level of comfort in integrating technology into their mathematics lessons.

Table 1.4: Attitude towards using ICT Tools

Attitude towards using ICT Tools	Mean	SD
1. I would like to learn more about integrating technology into my instruction planning	4.03	0.65
2. Using technology can improve my own understanding of certain mathematical concepts	4.16	0.71
3. Interesting mathematics problems can be explored using technology in mathematics	4.25	0.57
4. Using technology would make mathematics more difficult for me	3.53	1.11
5. ICT tools can be used to explore mathematics problems more deeply	4.06	0.62
6. ICT tools can improve student's understanding of certain topics	4.37	0.49
7. ICT tools would make teaching mathematics difficult for me	3.44	0.95
8. Teaching methods can be implemented in mathematics by integrating ICT tools	3.91	0.64
Grand Mean	3.96	

Table 1.4 indicates the attitude towards using technology or the need of technology use in mathematics as perceived by the pre-service teachers, a mean value of 3.96 indicates that the studied sample has a positive attitude towards using various ICT tools in mathematics and recognise the benefits for themselves as well as their learners.

Statistical Analysis of interview:

For data triangulation and gaining an in-depth understanding of the responses from the questionnaire, 12 pre-service teachers were selected for a semi-structured interview based on their level of comfort in using technology in their mathematics lessons and the various ICT tools they had reported in using in their mathematics classrooms. Only one respondent had reported as being uncomfortable in using technology. The other respondents had reported as being comfortable with technology integration, and had prior experience with working on computers.

The respondents were asked if they feel that ICT tools are needed to be introduced to them during the course about which all the respondents strongly believed that awareness regarding these should be given to them as part of the course/programme. Some responses given were: "Visualisation is important in mathematics, we can achieve this by using ICTs. Learning Disabilities can also be addressed using ICTs", "if made part of pedagogy subject then the knowledge would focus on (using in) maths", "we recognise the benefits but do not know how to use", "usage should be optional but information should be given in the pedagogy subjects", "if you want to teach your subject effectively then should be part of pedagogy subject, as part of CAI (Computer Assisted Instruction) should

be made part of the syllabus", "practical use as well as theory can be part of the syllabus"

The respondents were asked if the ICT training received as part of their curriculum was helpful for technology integration in their pedagogy subjects. Most of the respondents opined that the training just provided them with basic computer skills such as the use of word processors, spreadsheets and presentation software and for those who were already proficient in using computers and making PPTs it did not add to the existing technology skills.

In the questionnaire the respondents were asked the grade level(s) at which technology can be integrated into mathematics lessons, the reasons underlying their responses were explored during the interview. Out of 12, there were 8 teachers of the view that at primary level more hands on activities be given to children to introduce concepts than using ICT tools. Some responses were: "copy work is not important at primary level, they can catch the topic easily if we use computers.", "Not effective at primary level as technology usage makes the class teacher centered, so a smart board is not the best way to teach.", "at primary and elementary level more hands on activities in the form of concrete objects be provided", "at primary level the children are not mature enough to use computers"

A majority of the respondents were of the view that using ICT tools is effective at elementary and at subsequently higher levels. All the respondents agreed that it would be most effective to use technology at secondary and higher levels since abstract concepts are there. Some responses given were: "previous knowledge is there so helps in building up the concepts, it is better than giving cutouts of paper/cardboard etc. as these results in wastage (of resources)", "According to Piaget's stages also, abstraction develops at later stages (than primary), so effective at elementary level and higher.", "Since previous knowledge is there, concepts can be easily introduced using such software at secondary level unlike the case in primary and elementary level".

Two of the respondents were of the opinion that technology integration is effective at all levels since it is an interesting new way to learn and hence the participation of children is more, on the other hand, two respondents were of the view that technology can also make the class teacher centered. Their responses were: "ICT classes are taken casually, it feels like a co-curricular activity than academic one, it is time consuming and focus shifts from the content to the gadget", "At elementary & secondary level the copy needs to be filled then they have a feeling that mathematics has been done, so 70% talk 30% ICTs should be used." The pre-service teachers were asked if there are certain drawbacks of using technology in the classroom. The following six themes emerged from the responses of the trainee teachers: lack of awareness about ICT tools in mathematics, attitude of the trainees towards using technology for instruction, existing technology skills, availability of resources in schools, technical issues, and classroom management. The lack of awareness is because the various ICT tools were not introduced to the pre service teachers, there is also a reluctance towards using the technology, two respondents felt that the use of technology might shift the focus from content to technology. Because of limited previous experience with using technology pre service teachers do not feel comfortable in using technology in their mathematics classrooms. In most of the schools where they had interned the resources available were very limited, due to lack of support from school staff or administration gaining accessibility to the resources also became an issue. The responses recorded were: "technology usage is taken as co-curricular and not exactly as a curricular activity, no notes are taken in copies (while using technology)", "board work is important in mathematics, we can not just only use ICT", "Technical issues such as compatibility and connectivity issues might arise while using technology, there is discipline in the class while using technology at higher levels, at lower grade levels the classroom management might become an issue", "ICT and black board goes side by side, board is very important for mathematics.", "Discipline is more while using technology". Pre service teachers were also asked about what could be the possible reasons that most of the trainee-teachers have used MS Powerpoint or PPTs as part of ICT based lessons, the reasons that most of the trainee teachers used MS Powerpoint as an instructional tool were found to revolve around the following themes: Lack of knowledge/awareness about other ICT tools (6), easy to use, existing technology skills, unavailability of resources, and the attitude of the trainee teachers towards the use of technology.

There were 6 out of 12 pre service teachers who indicated that they have no awareness about other ICT tools than PPTs, while the other 6 out of 12 said that they already know how to make PPTs so that is why they have used them for teaching mathematics. "PPTs on various topics are already available (on the net)", "ready to use PPTs are there", "can depict visualisation better (than textbooks)", "Most schools have a projector so ppts is easy to use and we have been taught about ppts only as a part of ICT (classes)".

DISCUSSION OF THE FINDINGS:

Findings indicate that the pre service teachers use many ICT tools for planning their mathematics lessons (Table 1.1). However, the use of ICT tools in actual teaching in mathematics classrooms is mainly limited to use of presentation software (Table 1.2). A high level of perceived technology skills and a positive attitude towards using various ICT tools is there among the studied sample (Table 1.3 and Table 1.4). The responses from the interview also indicated in the same direction and that they would want to know more various other tools than just PPTs.

The role of the ICT training as part of the teacher preparation was found to be limited to providing them with basic computer skills such as the use of MS Office and for those who were already proficient in these, it did not add to the existing skills in using ICT tools in mathematics classroom teaching.

There are certain drawbacks of using technology too as perceived by the pre-service teachers. The major themes that emerged were: lack of awareness about ICT tools in mathematics, attitude of the trainees towards using technology for instruction, existing technology skills, availability of resources in schools, technical issues, and classroom management.

CONCLUSION:

In the studied sample the use of technology or ICT tools in mathematics teaching was found to be primarily limited to the use of presentation software or in the form of PPTs. It was also observed by the researcher that ICT term and PPT have been used synonymously by the various respondents during the interview. The usage was limited to this mainly because there is also a reluctance towards using other technologies in mathematics classrooms mainly because of limited previous experience with using ICT tools.

It was also found that the use of ICT tools in mathematics is mainly as a general tool: a replacement for the conventional use of black boards and textbooks, but the use as a visualisation tool specific mathematics tools such as mathematics software and apps is minimum and focus is more on presentation software involving both the videos and picture. The actual mathematical exploration thus developing mathematical abilities of problem solving, abstraction and visualizing mathematics other than just routine algorithms is very limited, the focus among pre-service teachers was found mainly on the routine solving of the exercises.

A positive attitude is found among the pre-service teachers about learning and exploring the various ICT tools in mathematics. Most of the pre-service teachers feel that ICT enabled lessons are effective at secondary and higher levels as abstract concepts can be dealt with easily and are not effective at primary levels where concepts should be given using more hands-on activities using concrete objects.

It is recommended that awareness about different kinds of ICT tools for mathematics such as lesson planning tools, mathematics software, web applications, concept mapping software etc. be given to pre-service teachers. The practical sessions with these should be integrated as part of the curriculum, thus enabling the preparation of future teachers who recognise and utilise the potential of technology in their mathematics teaching and learning.

REFERENCES:

1. Bennison A., Goos, M. (2010). Mathematics Education Research Journal. Learning to teach mathematics with technology: A survey of professional development needs, experiences and impacts. Volume 22, p 31–56(2010). Retrieved from <https://link.springer.com/article/10.1007/BF03217558>
2. Keong, C. C., Horani, S., Daniel, J. (2005). A Study on the Use of ICT in Mathematics Teaching. Malaysian Online Journal of Instructional Technology (MOJIT). Vol. 2, No. 3, pp 43-51 December 2005. ISSN: 1823- 1144. Retrieved from <https://pdfs.semanticscholar.org/0419/ba0310ac083bdb277238c5800a059ccd142c.pdf>
3. National Council of Educational Research and Training. (2005). National Curriculum Framework. New Delhi: NCERT.
4. National Council of Teacher Education. (2010). National Curriculum Framework for Teacher Education. New Delhi.
5. National Council of Teachers of Mathematics. (2011). <https://www.nctm.org/Standards-and-Positions/Position-Statements/Strategic-Use-of-Technology-in-Teaching-and-Learning-Mathematics/>
6. Umoh, B. J., Akpan, T. E. (2014). Challenges of Blended E-Learning Tools in Mathematics: Students' Perspectives University of Uyo. Journal of Education and Learning. Vol. 3, No. 4; 2014. Doi: <http://dx.doi.org/10.5539/jel.v3n4p60>.
7. Wachira, P., Keengwe, J. (2011). Technology Integration Barriers: Urban School Mathematics Teachers Perspectives. Journal of Science Education and Technology. 20. 17-25. Doi 10.1007/s10956-010-9230-y